TECHNICAL SPECIFICATIONS

1. PREAMBLE

1.1 The Technical Specifications contained herein shall be read in conjunction with the SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (FIFTH REVISION) April 2013.

1.1.1 General

The Technical Specifications covering the materials and the workmanship aspects as well as method of measurements and payments are included in this section. These specifications cover the items of civil and non-civil works coming under scope of this document. All work shall be carried out in conformity with the same. These specifications are not intended to cover the minute details. The works shall be executed in accordance with good practices followed for achieving high standards of workmanship, thus ensuring safety and durability of the construction. All codes and standards referred to in these specifications shall be the latest thereof, unless otherwise stated.

1.1.2 Inclusive Documents

The provisions of General Conditions of Contract, those specified elsewhere in the tender document, as well as execution drawings and notes, or other specifications issued in writing by the Engineer shall form part of the Technical Specifications of this project.

1.1.3 The attention of the Contractor is drawn to those clauses of codes, which require supporting specification either by the Engineer or by mutual agreement between the supplier and purchaser. In such cases, it is the responsibility of the Contractor to seek clarification on any uncertainty and obtain prior approval of the Engineer before taking up the supply/construction.

1.1.4 Measurement and Payment

The methods of measurement and payment shall be as described under various items of the Specification and in the Bill of Quantities. Where specific definitions are not given, the methods described in BIS Code will be followed. Should there be any detail of constructionor materials which has not been referred to in the Specification or in the Drawings and Bill of Quantities but the necessity for which may be implied or inferred there from, or which isusual or essential to the completion of the work in the trades, the same shall be deemed to be included in the rates and prices entered by the contractor in the Bill of Quantities.

1.1.5 Defective Works

All defective works are liable to be demolished, rebuilt and defective materials replaced by the contractor at his own cost.

1.2 Site Information

1.2.1 The information given hereunder and provided elsewhere in these documents is given in goodfaith by the Employer but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim will be entertained on the plea that the information supplied by the Employer is erroneous or insufficient.

1.2.2 General Climatic Conditions

1.2.2.1 The normal variation in temperature in this region is as under:

i) During summer months, the temperature rises up to 47^{o} C.

ii) During winter months, the temperature falls up to 8.5^{o} C.

1.2.2.2 The average annual rainfall is 1300 mm in the area.

1.2.3 Seismic Zone

The works are located in Zone II (Least Active Zone).

2. GENERAL REQUIREMENTS

The Technical Specifications in accordance with which the entire work described hereinafter shall be constructed and completed by the Contractor shall comprise of the following:

2.1 Part-I: General Technical Specifications

The General Technical Specifications shall be the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision) April 2013" issued by the Ministry of Road Transport and Highways, Government of India and published by the Indian Roads Congress, henceforth called MORT&H Specifications and deemed to be bound into this document.

2.2 Part-II: Supplementary Technical Specifications

The Supplementary Technical Specifications shall comprise of various Amendments / Modifications / Additions to the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS" referred to in Part-I above and Additional Specifications for particular item of work notalready covered in Part - I.

2.2.1 A particular clause or a part thereof in "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision) April 2013)" referred in Part-I above, where Amended/ Modified/ Added upon, and incorporated in Part-II, referred to above, such Amendment/Modification/ Addition supersedesthe relevant Clause or part of the Clause.

2.2.2 The Additional Specifications shall comprise of Specifications for particular item of works notalready covered in Part-I.

2.2.3 When an Amended/Modified/Added Clause supersedes a Clause or part thereof in the said Specifications, then any reference to the superseded Clause shall be deemed to refer to the Amended/Modified/Added Clause or part thereof.

2.2.4 In so far as Amended / Modified / Added Clause may come in conflict or be inconsistent with any of the provisions of the said MORT&H Specifications under reference, the Amended / Modified / Added Clause shall always prevail.

2.2.5 The following Clauses in the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision) April 2013" have been Amended/Modified/Added upon:

Sl.	Section No.	Section Title	Clause No.
1.	100	General	102, 103, 106, 107, 108,109, 111, 112, 114 and 120
2.	200	Site Clearance	201
3.	300	Earthwork, Erosion Control and Drainage	301, 305 and 306
4.	400	Sub-bases, Bases (Non-Bituminous) and Shoulders	401 and 406
5.	500	Bases and Surface Courses (Bituminous)	501, 502, 503, 505 and 507
6.	800	Traffic signs, Markings and other Road Appurtenances	803, 806, 807 and 811
7.	900	Quality Control for Road works	903
8.	1000	Materials for Structures	1006, 1007,1008, 1009, 1010
9.	1100	Pile Foundations	1101, 1103
10.	1500	Form Work	1501, 1503, 1504, 1506, 1508
11.	1600	Steel Reinforcement	1602, 1604, 1605, 1606
12.	1700	Structural Concrete	1707 and 1716.
13.	1900	Structural Steel	1903
14.	2100	Open Foundations	2104, 2106
15.	2200	Substructure	2204 and 2210
16.	2700	Wearing Coat and Appurtenances	2702
17.	2900	Pipe Culverts	2911
18.	3000	Maintenance of Road	3001
19.	3100	Reinforced Soil	3102, 3103, 3105

2.2.6 Additional Specifications

The Clauses A-1 to A-5 have been added to the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS".

CLAUSE A-1 : ADDITIONAL SPECIFICATION FOR FLY ASH AND SAND MIX FOR SUBGRADE FILL MATERIAL

CLAUSE A-2 : ADDITIONAL SPECIFICATIONS FOR MAINTENANCE OF RIGHT OF

WAY**CLAUSE A-3 :** ADDITIONAL SPECIFICATION FOR GEOTECHNICAL INVESTIGATION

CLAUSE A-4 : VOID FORMER

CLAUSE A-5 : PVC DOWNTAKE PIPE

CLAUSE A-6 : TEMPORARY BARRICADE

In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specifications of IRC, BIS, BS, ASTM and AASHTO in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the Engineer.

2.3 The latest edition till 60 (sixty) days before the final date of submission of the bid of all Specifications /Standard shall be applicable.

PART II

SUPPLEMENTARY TECHNICAL SPECIFICATIONS

(AMENDMENTS / MODIFICATIONS / ADDITIONS TO EXISTING CLAUSES OF GENERAL TECHNICAL SPECIFICATIONS)

SECTION 100 GENERAL

CLAUSE 102 DEFINITIONS

The following abbreviations shall be added in this Clause:

"MORT&H"	: Ministry of Road Transport & Highways (Previously known as „MOST", Ministry of Surface Transport).
"WBM"	: Water Bound Macadam.
"WMM"	: Wet Mix Macadam
"CPCB"	: Central Pollution Control Board
"CECRI"	: Central Electro Chemical Research Institute
"MDD"	: Maximum Dry Density (as per IS: 2720 – Part 8)
"RM"	: Running Meter
"VG"	: Viscosity Grade
"QA"	: Quality Assurance

CLAUSE 103 Add at the end of the clause

The latest edition of these standards till 60 (sixty) days before the final date of submission of the tender shall be adopted.

CLAUSE 106 CONSTRUCTION EQUIPMENT

Add the following at the end of sub-para (k)

No equipment used in the work shall be more than 7 years old.

CLAUSE 107 DRAWINGS

Clause 107.2 Add the following at the end of para

The fabrication drawings and erection/launching scheme (along with design calculations) for the girders for ROB and major bridges shall also be prepared by the contractor and submit to the Engineer for approval prior to the commencement of construction.

For ROBs, as required by the Railway Authority, Contractor shall prepare fabrication, erection, launching scheme drawing in compliance to the requirements of the concerned zonal railways, modify and incorporate comments of the railways and procure approval in consultation with and under the direction of the Engineer.

CLAUSE 108 SITE INFORMATION

Clause 108.4 (New Clause) Add the following:

The Contractor shall identify the source of sand, quarries for aggregates, borrow areas and other sources of materials required for the work. He shall satisfy himself that the required materials are available in adequate quantities and are complying with the requirements of the Specifications. He shall also satisfy himself about the availability of materials during the monsoon and make adequate arrangements for proper stacking so as to maintain the construction schedule. No claims shall be entertained on account of non-availability of materials and increase in leads.

It is the sole responsibility of the contractor to arrange the quarries, borrow areas etc. on license / lease basis or otherwise and study in detail the scope of taking the quarry on lease if required. Advance information must be collected by the contractor regarding the procedure laid down and the consequent delay in arranging the quarries on lease and he must make alternative arrangement to procure the quarry products from lease holders. No separate payment will be made for arranging such quarries, borrow areas. The Quarries & borrow areas shall be demarked & approved by the Engineer before use in the work. The contractor must satisfy himself about the rates towards royalty charges to be deposited for all the borrowed and quarry materials including fly ash if applicable.

CLAUSE 109 SETTING OUT

Clause 109.1 Add the following para in the Clause 109.1

The contractor shall provide the necessary surveying equipment, accessories, and surveyors and labours required for setting out and related measurements, including making available these tothe engineer and his representatives at different stages of the work. Contractor shall be responsible for providing precision survey instruments for setting out the work. The surveyingequipment shall be approved by the engineer, be in good working condition inadequate numbers and shall include, inter-alia, the following:

i. Digital level with tripods and levelling staff reading to 5mm accuracy by direct observation and to 1mm accuracy by estimation or better.

ii. Digital level with tripods and levelling staff reading to 5mm accuracy by direct observation and to 1mm accuracy by estimation or better.

iii. Total station with 2 spare batteries and a charger, three tripods plus tangents sufficient for a 4 km range, together with an electronic data recorder, 6 data packs and all necessary software for operation.

iv. Precision staff.

v. 3-meter straight edge and measuring wedge fitted with handles wedges 100 mm ht. And 1 mm accuracy.

vi. Field Umbrellas

vii. Ranging rods 50 mm dia 3 m long straight with one end each metallic conical and painted alternatively black and white along the length.

viii. Camber Templates 3 lane fitted with handles.
ix. Steel tape graduated in meters, centimeter and millimeter
a) 10 m long
b) 20 m long
c) 50 m long
d) Reference markers and pegs

The Contractor shall maintain the surveying equipment in good condition during the full duration of works and replace the ones, which get worn out or otherwise become unworkable.

The survey equipment will be calibrated against its accuracy time to time.

CLAUSE 111 PRECAUTIONS FOR SAFEGUARDING THE ENVIRONMENT

Clause 111.3 Quarry Operations

Add the following:

Contractor shall ensure scheduling the movement of transport carrying material to and from site during non-peak hours. The trucks carrying dusty material sand / fly ash shall be covered with tar Pauline and provided with adequate free board to prevent spillage. End boards shall be provided in loaders to prevent spillage. Stockpiling of material shall be properly planned so as to ensure that no traffic jam takes place on the project corridor.

Water tankers with suitable sprinkling system shall be deployed along the haulage roads and in the work sites. Water shall be sprinkled regularly all along the routes to suppress airborne dusts from truck/dumper movements particularly on unpaved roads. Actual frequency will be agreed with the Engineer to suit site conditions."

Clause 111.10 Control and Disposal of Wastes

Add the followings at the end of the sub - Clause:
Spilling of oil and bituminous products during construction and transport shall be avoided to reduce the chances of contamination of surface as well as ground water.
Degraded materials shall be disposed of in a manner as approved by the Engineer and wastewater shall be disposed into septic tanks and soak pits etc. The Contractor shall make arrangements to cleanup spoil as soon as the work finishes in a stretch. If such sites are located outside the ROW, restoration of the site to a level acceptable to the land owner(s) will be carried out within a time period agreed between landowner(s) and the Contractor. Separators shall be used to separate POL materials from wastewater prior to discharging to the watercourses or as approved by the Engineer in conformance with directives and guidelines.

CLAUSE 112 ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

Clause 112.1 General

Replace the following at 3rd sentence of 1st para:

"Two weeks before undertaking work which would involve any obstruction whatsoever to traffic, the Contractor shall submit, for the Engineer's approval, a Traffic Control Plan.

CLAUSE 114 SCOPE OF RATES FOR DIFFERENT ITEMS OF WORK

Clause 114.2 Add the followings at the end of sub-Clause ii):

The Contractor shall submit data via electronic media to the Engineer in a form readily compatible with Engineer's planning system.

Monthly progress report will be submitted in a format acceptable to the Engineer. The report shall state the progress which has been achieved compared with the planned progress, illustrate delays in proportion to the progress planned, analyze the consequences and state planned corrective measures. Intermediate progress reports may also be required.

The first issue of the detailed construction programme including the detailed description of the system and the procedures shall be submitted to the Engineer for acceptance not later than 28 days after the date of receipt of the letter of acceptance.

The contractor shall submit to the Engineer for approval the updated & revised programme at every three months interval or as such as directed by the Engineer. The updated & revised programme shall be submitted showing the actual progress achieved (physical & financial) and the effects of the progress achieved on the timing of the remaining work including any change to the sequence of the activities.

Clause 114.4 (New Clause)

If any work executed by the Contractor does not meet the specifications, it shall be as rejected.

Clause 120 FIELD LABORATORY

Add the followings after sub-Clause 120.2

The laboratory set-up must be complete including a set of reference standards, adequately staffedand operational to the satisfaction of the Engineer not later than 1 month from the date of receiptof Notice to commence the works.

The Contractor shall be responsible for the provision of adequately experienced and qualified laboratory staff, in sufficient numbers to be able to meet all testing requirements to the approval of the Engineer and for the supply of all transportation of staff, testing equipment and samples necessary to allow the testing to be performed in a time scale compatible with the needs of the Site.

Contractor shall arrange to maintain the laboratory in satisfactory manner and will carry stocks of spare equipment and laboratory consumables until the issue of Taking Over Certificate.

In addition to the above, the Contractor shall arrange any other equipment for carrying out testing required for quality control as per the Specifications.

Clause 120.5 Rate

Replace the para with the followings;

Construction of laboratory in the land arranged by contractor, equipment and instruments, calibration etc. and maintenance of laboratory including reagents and consumables shall be payable as per provision in the BOQ. Equipment and instruments shall be property of contractor.

SECTION 200 SITE CLEARANCE

CLAUSE 201 CLEARING AND GRUBBING

Clause 201.1 Scope

Substitute the following at the last sentence

Clearing and grubbing shall be performed less than two weeks in advance of earthwork operation and in accordance with requirement of these specifications.

SECTION 300 EARTHWORK, EROSION CONTROL AND DRAINAGE

CLAUSE 301 EXCAVATION FOR ROADWAY AND DRAINS

Clause 301.1 Scope

Add the following as second paragraph under this clause:

"The work shall also include excavation for canal training at culverts/bridges, excavation of existing shoulders and medians for purposes of widening the pavement and excavation of existing embankment for reconstruction to specification."

Clause 301.3.3 Excavation – General

The following paragraph is added to the sub-clause 301.3.3

"Temporary support to the sides of the excavation, necessary to support the foundation of adjoining structures and to prevent any ground movement shall be provided by the Contractor. Where temporary supports are provided these shall be designed & removed such that no ground movement occurs on removal. The Contractor shall submit his proposal in this respect to the Engineer for approval prior to commencement of the excavation".

Clause 301.3.5 Rock Excavation

The first sentence of first para shall read "Rock, when encountered in road excavation shall beremoved up to a level of 100mm below the base of WMM".

Clause 301.3.11 Disposal of excavated materials

Delete this Clause and replace with:

"All the excavated materials shall be the property of the employer. Suitable material obtained from the excavation of the roadway, shoulders, verges, drain, cross drainage works, etc. shall be used for:

i) Filling for roadway embankments, with all lifts and leads.

ii) Filling existing pits in the right of way as directed by the Engineer, including levellingand spreading, with all lifts and leads.

iii) For landscaping of the road as directed by the Engineer, including levelling andspreading, with all lifts and leads.

Excavated rock, if found suitable, shall also be available to the contractor for converting into aggregates and other item of works after taking prior approval of the Engineer and affording due credit in his bid proposal. Royalty for the quantity consumed shall be deposited with the concerned state government department.

Unsuitable and surplus material not intended for use shall be transported with all lifts and lead, disposed off or used as directed by the engineer. No place will be made available by the employer for disposing off the material and no claim will be entertained on that account.

Clause 301.6 Preparation of Cut Formation

Third para shall be read as under:

"In rock formation, either in full width or partial width, the rock shall be cut 100mm below the specified elevation of base WMM and the surface irregularities shall be corrected with granular material. The unsuitable material shall be disposed of in accordance with Clause 301.3.11".

CLAUSE 305 EMBANKMENT CONSTRUCTION

Clause 305.2 Material and General Requirements

Clause 305.2.1 Physical Requirements:

Clause 305.2.1.5 Add the following in the table:

Table 300-1
Density Requirements of Embankment and Subgrade Materials

SN.	Type of Work	Maximum laboratory dry unit weightwhen tested as per IS-2720(Part 8)
4)	Embankments with fly ash with earth cover on sides.	Not less than 11.5 KN/cum (for fly ash only)
5)	Embankment with fly ash with earth cover for embankment	Not less than 16.0 KN/cum (for soil only)
6)	Subgrade with fly ash and sand mix	Not less than 13.5 KN/cum (for fly ash& sand mix)
7)	Expansive clays	Not allowed

2.2.4 Compaction Requirements
Delete Table 300-2 and substitute the following:

Table 300-2
Compaction Requirement of Embankment and Sub grade

SN.	Type of Work/ Material	Relative Compaction as % age of maximum laboratory dry density as per IS-2720 (Part 8)
1	Subgrade and earthen shoulders	Not less than 97%
2	Embankment	Not less than 95%
3	High Embankment (Height >6m)	Not less than 97%
4	Expansive clays	Not allowed
5	Design CBR of Subgrade & Shoulder for the widened portion and new carriageway shall be as per drawing, but not **less than 8%.**	

New Clause 305.2.2.5 Pond Ash / Fly Ash as fill material

Pond ash / fly ash can be used as fill material for embankment and in mix with coarse sand as subgrade fill. The sides of the fill shall be covered with borrowed soil having PI values more than 12 but less than 20 to prevent erosion of the fill material. It shall be ensured that the fill material is not deposited in saturated condition. Compaction shall be carried out to minimum 97% of the maximum dry density at optimum moisture content.

The properties of the pond ash/fly ash to be used as fill material shall have the following characteristics:

Table 300-3

Properties of Ash for Fill Materials

SN	Parameters	Range
1	Specific Gravity	1.90 – 2.55
2	Plasticity	NP
3	MDD (gm/cc)	1.15 - 1.25
4	OMC (%)	18.0 – 26.0
5	Cohesion (kg/cm2)	0.0 -0.05
6	Angle of Internal Friction (φ)	30.00 – 35.00
7	Coefficient of consolidation, Cv, (cm2/sec)	1.75x10- 3 –1.90x10- 3
8	Compression index, Cc	0.05 – 0.1
9	Permeability (cm/sec)	7x10-5 – 5x10-3
10	Particle Size Distribution Clay size fraction Silt size fraction Sand size fraction Gravel size fraction	0.0 – 5.0 8.0 – 65.0 10.0 – 90.0 0.0 – 5.0
11	Coefficient of uniformity	3.1 – 10.5

Construction of Embankment using Pond ash/fly ash shall be carried out complete as per IRC: SP: 58-2001 as applicable. For subgrade fill, the pond ash/fly ash shall be mixed with sand (zone II / III, IS:383) in suitable proportion to achieve the dry unit weight given in

Table 300-1. Minimum sand content in the mix shall not be less than 30% by weight of the totalmix in any case.

Clause 305.3 Construction Operations

Clause 305.3.6Compaction

Insert the following sentence before the last sentence of Paragraph 4.

"The co-relation between sand replacement densities and nuclear gauge densities shall be based on trials with minimum 30 coherent density measurements".

CLAUSE 306 SOIL EROSION AND SEDIMENTATION CONTROL

Clause 306.4 Measurements for Payment

Substitute Clause 306.4 as follows:

"All temporary sedimentation and pollution control works shall be deemed as incidental to the earthwork and other items of work and as such no separate payment shall be made for the same."

Clause 306.5 Rates

This clause shall be deleted.

SECTION 400 SUB-BASES, BASES (NON BITUMINOUS) AND SHOULDERS

CLAUSE 401 GRANULAR SUB BASE

Clause 401.1 Scope

Add the following at the end of this Clause:

"A site trial shall be performed using the proposed mix. The trial length of minimum 30m and for full width of the pavement shall be constructed outside the main works. The main work shall not start until the trial length has been approved by the Engineer. After approval has been given, the material and mix proportions, construction procedures shall not be changed without the approval of the Engineer. In case, the trial length is made on the main work, it shall be removed".

Clause 401.2 Materials

Clause 401.2.1 First two sentences of the paragraph shall be substituted with the following:

"The material to be used shall be crushed stones only. The material shall be free from organic or other deleterious constituents. The portion of the total aggregate passing 4.75 mm sieve shall have a Sand Equivalent Value of not less than 75 when tested in accordance with the requirement of IS: 2720 (Part – 37)."

Clause 401.2.2 Delete the second sentence from the paragraph and add the following as second paragraph:

The Contractor shall, at least 15 working days before the commencement of the construction ofthe sub-base course, submit to the Engineer, the results for approval of the laboratory testing onthe physical properties defined above. The construction of the sub-base course shall be taken uponly upon the Engineer's approval of the material.

CLAUSE 406 WET MIX MACADAM SUB-BASE / BASE

Clause 406.2.1.1 Physical Requirements

Add the following after first paragraph:

"The constituents of the aggregates shall be produced by integrated crushing and screening plant unless otherwise instructed by the Engineer. The fraction of material passing through 4.75mmsieve shall also be crusher run screening only."

Clause 406.3.3 Preparation of Mix

3rd sentence of the last paragraph shall be read as

"However, at the time of compaction, water in the wet mix should not vary from the optimumvalue by more than $\pm$ 2 percent".

Clause 406.3.4 Spreading of Mix

Add after the last Paragraph:

The work of laying wet mix macadam shall not be done during rain.

The work of laying of wet mix macadam course over an existing bituminous layer shall not bepermitted. The existing bituminous layer shall be removed completely.

SECTION 500 BASE AND SURFACE COURSES (BITUMINOUS)

Clause 501.2 Materials

Clause 501.2.2 Delete "Crushed gravel or other hard material" from second line of Para 1."

CLAUSE502 PRIME COAT OVER GRANULAR BASE

Clause 502.2.1 Substitute the followings:

"The primer shall be cationic bitumen emulsion SS1 grade confirming to IS 8887 and shall berefinery produced. The particular grade to be used for the work shall be got approved by the Engineer."

Clause 502.2.3 Deleted

CLAUSE 503 TACK COAT

Clause 503.2 Materials

This clause shall be read as under:

"Binder: The binder used for tack coat shall be Cationic Rapid Setting (RS-1) bitumen emulsioncomplying with IS 8887 and shall be refinery produced."

CLAUSE 505 DENSE BITUMINOUS MACADAM

Clause 505.2.1 Bitumen: The bitumen shall be paving bitumen of viscosity grade VG 40 conforming toIS:73.

Clause 505.2.2 Coarse Aggregates

Delete the words 'crushed gravel or other hard material' from the first sentence of Clause 505.2.2.Delete para 2 of Clause 505.2.2.

Clause 505.2.4 The first sentence of this clause shall read as "Filler shall consist of rock dust orcement with minimum 2% by weight of aggregates."

The second paragraph shall be read as under:

Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-8, then anti-stripping agent, approved by the Engineer shall be added without additional cost.

Clause 505.2.5 Aggregate Grading and Binder Content

In Table 500-10, only the following two rows regarding Layer Thickness and Bitumen Grade shall be substituted as below keeping all other Items unchanged.

Grading	1	2
Layer Thickness	>75mm upto 100mm	50-75mm
Bitumen grade (Vis)	VG-40	VG-40

Clause 505.3 Mix Design

Clause 505.3.1 Requirements for the Mix

Add the following requirements to the list of Table 500-11:

- Water sensitivity (ASTM D1075): Retained stability (Ratio of Marshal Stability for 24 h Immersion and 30min Immersion in water at 60degree centigrade temperature) = not less than 75 %.

Clause 505.4.10 (New Clause)

"The Dense bituminous layers except Profile Corrective Course shall be laid with the sensorpaver capable of paving the full width in single operation."

CLAUSE 507 BITUMINOUS CONCRETE

Clause 507.2.1 Bitumen

This clause shall read as

"The bitumen use for the work shall be VG-40 grade, complying with IS:73".

Clause 507.2.5 Aggregate Grading and Binder Content

The Note below Table 500-17 shall be added with:

"The grading of the aggregate mix as used in work shall be a smooth curve within and approximately parallel to the envelope in Table 500-17".

Clause 507.3 Mix Design

Clause 507.3.1 Requirement for the mix

Add the following requirements to the list of Table 500-18:

- Water sensitivity (ASTM D1075): Retained stability (Ratio of Marshal Stability for 24 hImmersion and 30min Immersion in water at 60degree centigrade temperature) = not lessthan 75 %

Clause 507.4.2 (New Clause)

Add the following at the end of para:

"The Bituminous concrete layer shall be laid with the sensor paver capable of paving full widthin single operation".

SECTION 800 TRAFFIC SIGNS, MARKINGS & OTHER ROAD

APPURTENANCESCLAUSE 803 ROAD MARKINGS

Clause 803.2 Materials

This clause shall read as under:

"Road markings shall be hot applied thermoplastic compound with glass beads having at least70% spherical shaped particles and the materials shall meet the requirements as specified in Clause 803.4.

The road markings shall be laid in one layer with appropriate road marking machine approved by the Engineer. Before the road-marking machine is used on the permanent works, the satisfactoryworking of the machine shall be demonstrated on a suitable site, which is not part of the permanent works. The rate of application shall be checked and adjusted as necessary before application on a large scale is commenced, and thereafter daily."

Clause 803.3 Ordinary Road Marking Paint

This Clause shall be deleted.

Clause 803.5 Reflectorized Paint

This Clause shall be deleted.

CLAUSE 806 ROAD DELINATORS

Clause 806.2 This clause shall read as follows:

a) Triangular Object Marker shall be 300mm side with four red reflector, made out of 2mm thick aluminum sheet, face to be fully covered by high intensity grade white retroreflective sheeting of encapsulated lens type as per clause 801. The background/ border/ symbols shall be made by screen-printing of desired colour as per sign details.

b) The sign plate shall be fixed with 6mm dia. aluminium rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 40mmx40mmx5mm. The sign shall be fixed with nut-bolts & welding on MS pipe 50mm dia (NB-MW) and 500mm high.

c) Rectangular hazard marker 600mm x 300mm made out of 2mm thick aluminum sheet, face to be fully covered by high intensity grade white retro reflective sheeting of encapsulated lens type. The background/ border/ symbols shall be made by screen- printing of desired colour as per sign details. The sign plate shall be fixed with 6mm dia aluminium rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 40mmx40mmx5mm. The sign shall be fixed to 80mm dia (NB-MW) MS pipe.

d) Roadway Indicators shall be 1000mm high made with 100 mm dia. NB medium weight MS pipe. One reflector of high intensity grade retro reflective sheeting with encapsulated lens shall be provided on top of the reflector. The white & red reflector shall be provided alternatively of 40mm width, so that total width of reflector shall be 120mm. A wire mesh cover of 150mm height shall be provided on top.

e) All components of signs & supports shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. The sign backside shall be with grey colour and post shall be white colour / alternate white & black bands. The post below ground shall be painted with three coats of red lead

CLAUSE 807 BOUNDARY STONES

Clause 807.1 General

Add at the end of Para 1, "The boundary stones shall be of concrete as shown in drawing."

Clause 811 CRASH BARRIER

Clause 811.2.2 This clause shall be read as follows:

"Concrete crash barriers shall be constructed with M-40 grade concrete and High Yield Strength Deformed (TMT) Reinforcement conforming to IRC:21."

Clause 811.2.4 Measurements for Payment

This clause shall be read as follows:

"The concrete crash barriers shall be measured in Cubic metres of concrete placed in position excluding steel reinforcement as per drawing and accepted length of barrier in place.

Clause 811.6 Rate:

Add at the end of the clause:

"and paid as per respective BOQ items.

SECTION 900 QUALITY CONTROL FOR ROAD WORKS

CLAUSE 903 QUALITY CONTROL TESTS DURING CONSTRUCTION

Clause 903.4 Tests on Bituminous ConstructionClause

903.4.1 Add at the end of this Clause:

"The density test shall be carried out by 100 mm diameter core cutter machine on Dense Bituminous Macadam and Bituminous Concrete as per the frequency specified".

Add the following note at the end of Table 900-4:

Note:

1. *The laboratory and field tests shall be performed on materials and works at the frequency values indicated against each. The Supervision Personnel shall ensure that there are no deviations in this regard.*
2. *The Contractor shall prepare a detailed manual for Quality Assurance including the methodology for the respective tests, the data formats and the methodology for the analysis and interpretation of test results based on the reference Standards and Practices indicated in the Technical Specifications and obtain the approval of the Engineer.*

SECTION 1000 MATERIALS FOR STRUCTURES

CLAUSE 1006 CEMENT

Add the followings at the end of this clause:

Cement to be used for the work shall conform to the following standard:

a) IS: 8112 – Specification for 43 Grade Ordinary Portland Cement
b) IS:12269 – Specification for 53 Grade Ordinary Portland Cement
c) IS: 455 – Specification for Portland Slag Cement
d) IS: 1489 (Part-1)– Specification for Portland Pozzolana Cement (fly ash based).

For prestressed concrete structures, Ordinary Portland Cement conforming to grade 43 &53 shall only be used.

Mix design for each brand and type of cement shall be submitted for approval of the Engineer before being used in the works.

CLAUSE 1007 COARSE AGGREGATES

Delete from the first sentence "crushed gravel inert material" appearing in 3rd and 4th line of Para 1.

CLAUSE 1008 SAND / FINE AGGREGATES

Delete from the 1st line the word "crushed gravel" and from the 2ndline "gravel" in Para 2.

CLAUSE 1009 STEEL

Clause 1009.3 Reinforcement/ Un-tensioned steel

Add at the end of last para:

The other reference to "HYSD" bars in the Specifications shall be read as TMT bars.

All steel used in the works shall be procured from TISCO, SAIL, RINL. In case steel is obtained from other sources, these steel material shall be from primary steel producers having integrated steel plants adopting BF-BOF or Corex-BOF or DRI-EAF technology to produce liquid steel and crude steel with in-house rolling facility.

CLAUSE 1010 WATER

In Para (c) the permissible limit for Chlorides (Cl) shall be read as "250 mg/lit for structures having length more than or equal to 30 m."

In case of structures of lengths 30m and below, the permissible limits of chlorides may be increased up to 500mg/liter.

SECTION 1100 PILE FOUNDATIONS

Add the following before Clause 1101.1

Piling work shall be cast-in-situ bored piles of diameter as shown on the drawing. Boring / drilling, socketing of piles shall be done by using hydraulically operated rotary drilling machines only. Rock augers with conical shaped teeth made of tungsten carbide or diamond shall be used for cutting through the upper strata. For cutting through hard strata core cutters shall be used. The rotary, drilling equipment shall not be more than 5 years old.

Clause 1101.2 Add the following at the end of clause 1101.2**:**

The contractor shall submit information regarding proprietary system of piling as per Clause 115.4.

The Contractor in his method statement shall include the procedure for carrying out routine vertical and lateral load tests of piles including design calculations and drawings. The format for reporting test results shall be included in the method statement.

Clause 1101.4 Add the following as sub-clause 1101.4

The scope of work shall comprise the following:

a) Providing all materials including concrete, reinforcing steel, Bentonite slurry for stabilizing the bore, temporary casing as required, labour and equipment for installation of bored cast-in-situ piles in any situation including marshy soils, water logged land and back waters of sea.

b) Initial and routine testing of piles.

c) Provision of access to movement of Equipment, barricading where necessary, pollution control measures including measures to control noise to minimum acceptable levels and site clearance.

Clause 1103 TYPE OF PILES

Add at the Beginning:

Bored cast-in-situ piles as shown in drawings or as directed by the Engineer shall be provided.

Clause 1118 MEASUREMENTS FOR PAYMENT

Replace the 3rd para with the following:

"Routine Load Test shall not be measured for payment, whereas Initial Load Test shall be measured separately in number and is payable."

Clause 1119 RATE

Delete the 1st & 2nd para and add the followings:

"The contract unit rate for cast-in-situ bored piles shall include the cost of concrete and all other items as per Section 1700 of these Specifications. The contract unit rate shall also include costs of all labour, materials, equipments and all other incidentals involved in conducting routine load test."

SECTION 1500 FORMWORK

CLAUSE 1501 Description

The Clause shall read as below.

The Contractor shall prepare a formwork mobilization and utilization plan and submit the plan for Engineer's approval at least 28 days before the commencement of construction of structures. The requirement of formwork shall be worked out considering the overall construction program of all the structures to be cast in one or more stages, as specified in the drawings. The plan shall take into account the time required for erection of formwork, retention in position, stripping, and removal and subsequent use in the next and subsequent structures.

Notwithstanding Engineer's approval of mobilization plan, if due to any reason, Contractor has to arrange additional formwork, to meet the requirements of the construction program, it shall be done by the Contractor without any extra cost to the Employer/Engineer.

Clause 1503 DESIGN OF FORMWORK

Clause 1503.2 The following shall be added at the end of this Clause:

"For distribution of load and load transfer to the ground through staging, an appropriately designed base plate or grillage must be provided which shall rest on firm sub-strata".

CLAUSE 1504 WORKMANSHIP

Clause 1504.1 Add the following at the end of Clause 1504.1

The loading from the formwork shall be distributed to the soil or the permanent works below (e.g. pile cap) in such a manner that any total or differential settlement are within acceptable limits. Subsoil characteristics shall be taken into account while designing the staging to avoid untoward failures. All the pipes etc. used for staging shall be free from kinks, bends etc.

CLAUSE 1506 PRECAUTIONS

Add the following as items of this clause:

- Adequate support against sideway and lateral loads due to construction operations and wind shall be provided.

- In case cantilevers are supported directly from the ground, the supports for cantilevers shall remove simultaneously with main supports only after approval for the same fromthe Engineer.
- Forms shall be rigid and of adequate section to reduce deflections. Forms shall have sufficient rigidity to resist horizontal pressures caused by flowing concrete resulting from use of super plasticizers. The formwork shall resist the lateral pressure caused due to fast rate of placement by concrete pumps.

Clause 1508 REMOVAL OF FORMWORK

Add the following at the end of the paragraphs.

For prestressed units, the side forms shall be released, as early as possible and the soffit forms shall permit without restraint, deformation of the member, when prestressing force is applied. Form supports and forms for cast in situ members shall not be removed until sufficient prestress has been applied to carry the dead load and any formwork supported by the member and anticipated construction loads.

SECTION 1600 STEEL

REINFORCEMENTCLAUSE 1602

GENERAL

Paragraph 2 of Clause 1602 shall read as follows:

"Reinforcements shall be High Yield Strength Deformed (TMT) bars of grade Fe 500 conforming to IS: 1786 – 2008. Only uncoated steel shall be used as reinforcement unless specified".

All steel used in the works shall be procured from TISCO, SAIL, RINL. In case steel is obtained from other sources, it shall be with specific written instruction from the Engineer who in turn shall ensure that these are from primary steel producers having integrated steel plants adopting BF-BOF or Corex - BOF or DRI - EAF technology to produce liquid steel and crude steel with in-house rolling facility.

CLAUSE 1604 BENDING OF REINFORCEMENT

Para 1 & 2 of Clause 1604 shall be read as follows:

The reinforcement shown on the drawings shall be considered merely symbolic representations of the shape and position and shall not be used by the Contractors to justify any deviation from the stipulated requirements. Bar bending schedules and any supplementary drawings as may be required shall be furnished by the Contractor and got approved by the Engineer before start of work. The bending schedules shall state the number, shape and length of bar and weight in respect of each type. System of bar referencing should

be coherent and systematic. A separate bar bending schedule shall be prepared for auxiliary bars like spacers, chairs etc.

CLAUSE 1605 PLACING OF REINFORCEMENT

Paragraph (c) (i) of Clause 1605 shall be read as follows:

Cover blocks shall be made of concrete or cement mortar with the same durability properties as the surrounding concrete and with the same type of constituents. In visible surfaces, the cover blocks shall be of the same colour and texture as the surrounding concrete. The Contractor's proposal for cover blocks shall be submitted to the Engineer for acceptance.

CLAUSE 1606 BAR SPLICES

Clause 1606.1 Add the following as paragraph 2 of Clause 1606.1:

The location of joints in continuous reinforcing bars, not shown in drawings, shall be submitted to the Engineer for acceptance. If nothing contrary has been specified, the number of bars to be joined in any cross-section shall not exceed one-third of the total.

Clause 1606.2 Welding

Clause 1606.2.1 Add the following at the end of the paragraph.

In prestressed concrete members, when welding of un tensioned reinforcement is permitted bythe Engineer, it shall be carried out before insertion of the prestressing tendons/sheathing.

SECTION 1700 STRUCTURAL CONCRETE

CLAUSE 1707 EQUIPMENT

Para 1 of this Clause shall read as under:

"Unless specified otherwise, equipment for production, transportation and compaction of concrete shall be as under:

a) For production of concrete: Batching and mixing of the concrete shall be done in a concrete batching and mixing plant fully automatic. The plant shall be approved by the Engineer."

Paragraph 3 of this clause shall read as follows:
"The accuracy of measuring devices shall fall within the following limits:

Measurement of Cement in each batch.	±1% of the quantity of cement
Measurement of Water waterin each batch.	±1% of the quantity of
Measurement of Aggregate Aggregate in each batch.	±2% of the quantity of
Measurement of Admixture Admixture in each batch.	±1% of the quantity of

Serial no. b) & c) shall remain unchanged.

Add the following paragraph at the end of the clause:

Batching, mixing transportation and placing concrete.

Once the concreting of a section is started, it has to be completed as a continuous operation. Before starting an important placement, the Contractor shall submit to the Engineer an equipment list to ensure that sufficient equipment is available for batching, mixing, transporting and placing concrete and once the concreting of a section is started, it can be completed as a continuous operation within a reasonable time.

CLAUSE 1716 TOLERANCES

Add the following at the end of Clause:

"In the absence of any information in drawings or specifications, for particular cases, the following limitations shall apply.

Deviations from Position etc.

a)	Deviation from specified position in plan	± 10 mm
b)	Variation in levels at top	± 10 mm
c)	Variation of reduced levels of bearing areas	± 5 mm
d)	Variation in plumb over full height of piers	± 10 mm
e)	Surface irregularities measured with 3 m straight edge	
i)	all surfaces except bearing areas	± 5 mm
ii)	bearing areas ± 3 mm	
f)	Variation in length of superstructure - overall and length between bearings	± 10 mm Or +0.1% of thespan length, whichever is lesser

SECTION 1900 STRUCTURAL STEEL

Clause 1903.4 Paints

Delete para-2 and add the following as per IRS B1-2001 Clause No. 39.1and 39.2.1 as below.

1. No part of the work shall be painted or coated, packed or dispatched, until it has been finally inspected and approved by the Engineer. Dry Film Thickness shall be measured by elcometer or any other method approved by the Engineer.
2. When so specified by the Engineer, the whole of the work except machined surfacesshall be given protective coating using one of the systems of painting or metallizing given below in para 2.1. Prior to the application of protective coating, the surface of work shall be carefully prepared removing mill-scale, rust, etc. using wire brushes, sand or grit blasting as stipulated and approved by the Engineer.

2.1 For locations where the girders are subjected to salt spray such as in close vicinity of the

sea and/or over creeks etc. the protective coating by metallizing with sprayed aluminium followed by painting as per painting schedule given below may be applied:

(i) One coat of etch primer to IS:5666.

(ii) One coat of zinc chrome primer to IS:104 with the additional proviso that zinc chrome to be used in the manufacture of primer shall conform to type 2 of IS:51.

iii) Two coats of aluminium paint to IS:2339 brushing or spraying as required. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site, the second finishing coat shall be applied after touching up the primer and the finishing coat if damaged in transit.

Unless otherwise specified, paints shall conform to the relevant IS specifications. The paints which have been tested for the following qualities as per specifications given in the relevant IS codes only shall be used:

- Weight test (weight for 10 liter of paint, thoroughly mixed)
- Drying time
- Consistency
- Dry thickness and rate of consumption.

SECTION 2100 OPEN FOUNDATIONS

Clause 2104.1 Preparation of Foundations

Substitute M15 with M10 in the first paragraph

CLAUSE 2106 TOLERANCES

Reference to Tolerance shall be made to Clause 1716.

SECTION 2200 SUB - STRUCTURE CLAUSE

2204 PIERS AND ABUTMENTS

Add the following paragraph at the end of clause:

"Wherever necessary, suitable cofferdams or other means shall be provided to exclude water from the construction area. The Contractor shall provide necessary pumping equipment for dewatering areas".

Clause 2210 Rate

This Clause shall read as follows:

"The contract rate for masonry, concrete and reinforcement in substructure shall include all works as given in respective sections and cover the cost of incidental items like providing cofferdams, dewatering, providing special formwork, where necessary, and all other items forfurnishing and providing substructure as mentioned in this section."

The necessary material (thermocole, bituminous fibrous board or equivalent material) and labour, tools etc. required for maintaining 20 / 40 mm gap between faces of various structures (old / new) wherever required / as shown in drawing shall be incidental to work and shall not be measured / paid separately.

SECTION 2700 WEARING COAT AND APPURTENANCES

Clause 2702.1 Replace the Sub-para with the following:

Bituminous wearing coat shall comprise of 40 mm bituminous concrete overlaid with 25 mm thick bituminous mastic asphalt.

SECTION 2900 PIPE CULVERTS

Clause 2911 Payment of concrete works in pipe culvert including head wall, parapet wall and cradle to be constructed as per drawing, Technical specifications and as directed by Engineer will be paid separately as per provision of respective item in the Bills of Quantity (BOQ).

SECTION 3000 MAINTENANCE OF ROAD

Clause 3001: Add the followings at the end

1. The contractor will be responsible for maintenance of the road (existing as well as all permanent works) from the day the worksite is handed over till the possession of completed work is taken over.

2. The contractor will have to keep the road traffic worthy and in reasonably goodcondition throughout the construction period so as not to cause any inconvenience to the traffic.

3. During the construction period, contractor will have to attend to the following maintenance works from time to time to the satisfaction of the Engineer.

3.1. Restoration of rain cuts and dressing of side shoulders;

3.2. Maintaining public vehicular access along the ROW and from ROW to all public and Private accesses at all times and in good condition by carrying out repairs and maintenance as directed by the Engineer;

3.3. Maintenance of roadside and cross drains to ensure that drainage is not affected;

3.4. Filling potholes and patch repairs in bituminous surface with a bituminous pre-mix after trimming the pot hole / depression to proper shape and depth with necessary tack coat and proper compaction with road roller.

During construction period it would be necessary to divert the traffic from new carriageway to existing carriageway and vice-a-versa to facilitate undertaking of permanent works on existing carriageway. Construction of such diversions by cutting across central median and maintaining the same will be the contractor's responsibility and shall be at his cost.

SECTION 3100 REINFORCED SOIL

Clause 3102 Design

Add the followings at the end of para:

IRC: SP: 102-2014 (Guidelines for Design and construction of Reinforced soil walls)/BS:8006-1:2010 (Code of Practice for strengthened/reinforced soils and other fills) shall be followed.

The contractor shall need to assess and substantiate the availability and design adequacy

of soilsafe bearing capacity under the location of the wall before execution of the work.

Clause 3103 Reinforcing Element

Replace the Clause with the followings:

Reinforcing materials such as Geo-synthetics in the form of high tenacity polyester geostrips or geogrids with polyethylene coating shall be used as reinforcing element. The proposed polymeric reinforcement shall have proven experience of minimum 10 years internationally or in India and polymeric reinforcements having proven experience less than 10 years shall not be used. The selection of suitable reinforcing element shall be as per specifications given in the document and shall be approved by the Engineer.

Geo-synthetics

The material factors as per the guidelines given in ISO TR20432, for specified design life of reinforced soil wall structure and design temperature for the project, shall be used to determine the long term strength of the geosynthetic reinforcement for design of reinforced soil wall structure. The design temperature shall be evaluated based on definition given in FHWA-NHI-00- 043 and design life shall be 100 years. The agency should provide independently certified partial material factors to be considered in the design of RS Wall for the geosynthetic reinforcement for design temperature and design life of reinforced soil wall structure. The agency should also provide independently certified creep test data for the product with tests extending for minimum period of 10 years and independently certified creep properties and reduction factors for creep should also be made available at design temperature and design life of reinforced soil wall structure as per guidelines given in ISO TR20432. The agency should provide test reports of durability tests as per ISO TR 20432 and default value of 1.1 as per FHWA shall not bepermitted.

All quantity control strength of geosynthetics must represent minimum average roll values (MARV) corresponding to 95% confidence limit. Testing of geosynthetic for tensile strength shall be performed in accordance with ISO 10319 for every 20,000m of geostrips and test data for eachlot of material shall accompany shipments.

The geostrips shall be made from high molecular weight and high tenacity polyester (PET) yarns. The reinforcing elements to be used for the project shall be manufactured at ISO 9001:2008 certified production facility only. The polyester used for manufacturing geostrips should satisfy the following requirements:

- Minimum molecular weight no. > 25000
- Maximum carboxyl end group no. (CEG) < 30

Polyester geo-strips shall be provided with a protective polyethylene coating to maximize the resistance to hydrolysis and enhance durability and increase survivability during construction and in service.

Connection

Connection between the facia and the reinforcing element shall be using galvanised steel loops (minimum 10mm diameter) & toggles bars (minimum 25mm diameter) designed as per relevant Indian Standards. If polymeric connections are used or any components of connections are made of polymeric material, the agency shall provide the results of tests

carried out on the connection to establish the connection strength between the facia and reinforcing elements from independent accredited body or government agency /Institute as per the requirement of BS 8006. In the absenceof test report the connection shall be approved and must be tested.

QUALITY CONTROL AND TESTING OF MATERIALS

Testing shall be done as stated elsewhere in this specification on all materials required for reinforced soil structure construction. The tests shall be done from a reputed independent agency or at the manufacturer's facility under the presence of Engineer or his representative as and when required. All tests and testing certificates shall be submitted to the Engineer at least 7 working days prior to use of any material. Tests on materials before and during construction shall not be limited to the following types.

For Geosynthetic reinforcing elements

i. Tensile strength certificate from the supplier for each lot.

ii. Testing at manufacturer's facility witnessed by Engineer's representative to verify the test results.

iii. Determination of interaction coefficients by shear box test, maximum once in a project, if the values used in design are not as per the codes of practices, otherwise at owner's costs.

iv. The following particulars of the proposed geosynthetic reinforcing elements and connections shall be submitted to the Engineer:

a. Literature on the proposed reinforcing element and connection.

b. Copies of valid quality assurance certificate such as ISO 9001 or equivalent certifying the quality system for the manufacturing of the reinforcing elements.

c. A certificate showing the manufacturer's name, the date and place of manufacture and showing that the reinforcing element complies with the requirements stated in the contract and including the results of tests specified in the contract or as specified by the Engineer.

v. Samples of the reinforcing elements and connections shall be submitted to the Engineer at the same time as particulars of the material are submitted.

Joint Fillers:

i. Bedding material between the horizontal joints (excluding the joint between the PCC base and The bottom most panel) of the panels shall consist EPDM (Ethylene Propylene Diene Monomer) material/pad. Whereas the bedding material between the PCC base and the bottom most panel shall consist of either cement mortar or durable gasket seating such as resin bonded cork, bitumen bonded cork or EPDM.

ii. Sealing material for filling joint gaps, if required, other than bedding joints shall consist ofclose

iii. cell polyurethane foam strip or non-woven polypropylene/polyester Geotextile of unit weight not less than 125 g/m^2.

iv. The joints (vertical and horizontal) between the panels shall be covered from inside with non woven polypropylene/polyester geotextile strips glued to the facing element ensuring full coverage of joints. Synthetic glue shall be used for this purpose. The width of the geotextile strip shall not be less than 100mm."

Clause 3105 Facia Material

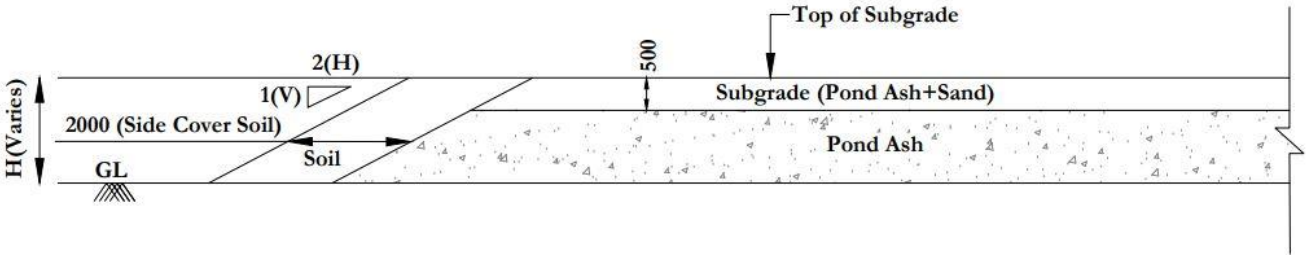
Substitute the Clause from 3105.1 to 3105.3 with the followings:

The facia panel shall be precast reinforced concrete **cruciform-shape panels** with nominal thickness of 180 mm, including facing textures, logos and embellishments. The grade of concrete shall be minimum M35. The concrete shall confirm to the requirements of Section 1700 of these Specifications.

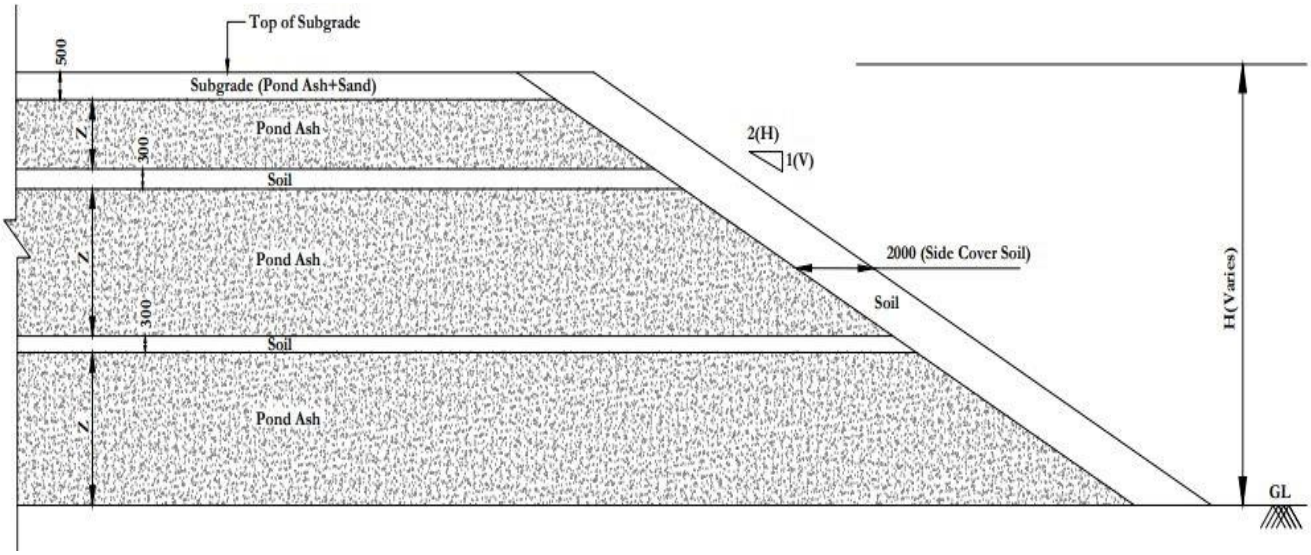
The facia panels shall have provision of both horizontal and vertical gaps to prevent concrete to concretecontact.

ADDITIONAL TECHNICAL SPECIFICATIONS

CLAUSE A- 1 ADDITIONAL SPECIFICATION FOR FLY ASH AND SAND MIX FORSUBGRADE FILL MATERIAL



SCHEMETIC DIAGRAM FOR CONSTRUCTION OF EMBANKMENT WITH ALTERNATE LAYERS OF POND ASH AND SOIL (FOR HEIGHT < 3m)



SCHEMETIC DIAGRAM FOR CONSTRUCTION OF EMBANKMENT WITH ALTERNATE LAYERS OF POND ASH AND SOIL (FOR HEIGHT<3M)

1 General

Pond ash/fly ash can be used as fill material for embankment and in mix with coarse sand as subgrade fill. The sides of the fill shall be covered with borrowed soil having PI values more than 12 but less than 20 to prevent erosion of the fill material. It shall be ensured that the fill material is not deposited in saturated condition. Compaction shall be carried out to minimum 97% of the maximum dry density at optimum moisture content.

2 Material

The properties of the pond ash/fly ash to be used as fill material shall generally have the following characteristics:

In case of any deviation in values if any characteristics of the fly-ash, excepting MDD and Plasticity, Contractor shall bring it to the Notice of the Engineer, prior to using such fly-ash material, which can be used only on specific prior approval of the Engineer

CLAUSE A-2 ADDITIONAL SPECIFICATIONS FOR MAINTENANCE OF RIGHT OF WAY

Throughout the period of the Contract the Contractor shall at all times maintain public vehicular access along the right-of-way and from the right-of-way to all public and private access and land, as exists immediately prior to his commencement of the Works.

The Contractor may on written request to the Engineer, (including a drawing, program and specification), be given approval to operate:

(a) a road diversion suitable for the road traffic and suitable width, or

(b) traffic on a one way system using manual coordinated direction control or automatictraffic lights having a secure source of power.

Sl. No.	Parameters	Range
1	Specific Gravity	1.90 – 2.55
2	Plasticity	NP
3	MDD (gm/cc)	1.15 - 1.25
4	OMC (%)	18.0 – 26.0
5	Cohesion (kg/cm^2)	0.0 -0.05
6	Angle of Internal Friction (φ)	30.0^0 – 35.0^0
7	Coefficient of consolidation, C_v, (cm^2/sec)	$1.75x10^{-3}$ – $1.90x10^{-3}$
8	Compression index, C_c	0.05 – 0.1
9	Permeability (cm/sec)	$7x10^{-5}$ – $5x10^{-3}$
10	Particle Size Distribution Clay size fraction Silt size fraction Sand size fraction Gravel size fraction	 0.0 – 5.0 8.0 – 65.0 10.0 – 90.0 0.0 – 5.0
10	Coefficient of uniformity	3.1 – 10.5

Applications for approval shall show every detail of the proposals including road

construction (cross section including pavement and surfacing, and profile and drainage), road signing, communication between the ends of the controlled section lighting and proposed period of operation.

One way systems shall be provided with adequate sign posting and the Contractor shall limit delays to any traffic to the minimum and with the approval of the Engineer. The travelling public shall be notified by signs, of exceptional delay well in advance of the site of delay, as required by the Engineer.

Payment for temporary diversions, traffic provisions and maintenance of roadways shall be asprovided in the Contract and as instructed by the Engineer**.**

CLAUSE A-3 GEOTECHNICAL INVESTIGATIONS (DETAILED EXPLORATION)

1. SCOPE OF PROPOSED INVESTIGATIONS

The exploratory Geotechnical Investigations are required to be conducted at location. All geotechnical investigation shall be done through Agency approved by the Engineer.

This work shall be considered incidental to the foundation works and nothing extra shall be paid.

The scope of the geotechnical investigation is discussed below and is given in the Bill of Quantities.

The present scope of work includes drilling of exploratory boreholes, collection of disturbed and undisturbed samples, conducting Standard Penetration Tests and Vane Shear Tests and all other required laboratory tests.

2. SPECIFICATIONS

FIELD WORK

a) Boreholes

The borehole diameter shall be of adequate size (at least 150 mm) to obtain 100mm diameter undisturbed samples from the borehole. The borehole depths are likely to vary depending on location. The probable maximum depth is likely to be about 55 to 60m.Field testing in boreholes includes Vane Shear Tests and Standard Penetration Test as stipulated by the engineer during execution. Sampling in boreholes includes undisturbed and disturbed sampling of all types of materials, rock cores and groundwater. All field and laboratory testing shall be conducted in accordance with relevant IS Codes and as stipulated by the Engineer.

b) Drilling in Soils Other Than Rock

The boreholes should be drilled at the locations indicated on the drawing to be furnished by the Engineer.

Rotary drilling rig preferably hydraulically operated, with drill pipes and drill bits, swivel type double tube core barrels of M-series with matching diamond bits/triple tube core barrels or type as required by the Engineer, undistributed soil samplers like push sampler/piston samplers, SPT equipment, drilling mud chemicals, all consumables and all other accessories and spares as required for investigations in all kinds of soils and rocks shall be mobilized by the contractor. The rotary drill method shall be preferred to shell and augur method while boring in soil. Calyx type drilling rigs shall not be allowed under any circumstances. The method of advancing the borehole in soil overburden by establishing the sides of the boreholes by drilling mud (Bentonite) is considered preferable to casing of the borehole. Drilling should be carried out in such a manner as to limit disturbance of the soil to be

sampled or tested to a minimum. Washing tools should have proper side jets and under no circumstances will bottom discharging tools be permitted. The insert casing shall be sufficientto allow for in-situ sampling and testing with standard sampling and testing tools.

Electronic theodolite and other necessary survey equipment shall be mobilized along with necessary personnel for operation of the same for positioning of the borehole locations and measuring ground levels.

All personnel required for round-the-clock operations including a graduate engineer in each shift should be available at site. All such personnel mobilized for each shift of 12 hours shall have minimum of three years of experience in the same type of job. The project in-charge shall be a post-graduate geotechnical engineer with minimum of five years of experience in the same type of job.

The borings shall be carried out in accordance with relevant Indian Standard Code of Practice and the requirements stated herein. The boring, sampling and in-situ testing shall be carried out in a manner approved by the Engineer who shall have the right to order alternative procedures if he is not satisfied with the quality or accuracy of the work.
The observations during boring shall be put down in such a manner, so that each change in strata is accurately determined to the satisfaction of the Engineer. During the boring operation, particular attention shall be paid to the disturbed material washed up or brought up by the shell and auger, and these shall be described in the boring logs. These disturbed materials should be preserved in polythene bags with tags stating borehole reference, depths, nature of soil etc.

The work of drilling in soil shall be carried out in such a manner that disturbed as well as undisturbed samples of soil can be conveniently collected at the required depths/intervals, and penetrometer tests can be carried out if required. The Contractor shall adopt such a method, which will permit the collection of samples indicating the grain size distribution of natural strata without loss of fines, covering the entire depths.

Water samples shall be collected from the boreholes. Water samples shall be collected prior to addition of Bentonite to boreholes. If this is not possible then prior to collection of water samples, the borehole shall be dewatered by about half a meter depth and water allowed rising back prior to sampling. Ground water level for each borehole shall be checked during boring operation and shall be recorded in bore log.

The drilling operations may be interrupted for collecting the samples, probing and conducting penetrometer tests etc. The casing pipes shall not be removed unless directed by the Engineer. Even after removal of the casing, a piece of pipe should be left in the borehole to identify the location.

The Contractor shall ensure that sand-blow conditions do not develop while drilling, sufficient surcharge of water or drilling mud should be maintained all throughout the drilling operation.

In the exploration programme the contractor shall associate with the provisions of IS:1892.

c) Undisturbed Soil Samples

In overburden undisturbed samples shall be recovered from the borings at intervals not exceeding 3m and at every change of strata. The undisturbed sampling shall conform to IS Code 2132 (1972). Undisturbed samples shall be collected in returnable tubes of 100mm internal diameter. Attempts should be made to collect undistributed soil sample of 500mm to 600mm in length.

The sample tube shall have a proper identification mark painted on it (e.g. borehole reference, depth, location, arrow mark indicating bottom end of the sample tube etc.). The moisture in undisturbed samples shall be carefully preserved by sealing both ends of the sample tube by applying a double coat of cotton waste and paraffin wax.

d) Disturbed Soil Samples

Disturbed soil samples shall be collected from boreholes. These shall include soil samples collected from the split spoon samples and also from the cutting edges of UDS.
The samples shall be stored in plastic bags.

e) Drilling in Rock

In general, boreholes should be taken to relatively hard strata. Should rock be encountered in soil borings, it shall be proven by core drilling for a penetration of at least 3 m, or as directed by the Engineer. Rock cores shall be retrieved in minimum NX size by using swivel type double or triple tube core barrels with a suitable core catcher and diamond bit. Single tube core barrels or calyx type drills will not be permitted. Drilling mud or any other fluid likely toaggravate core slips shall not be used.

If required, in all types of rock, the borings will be extended more than the depths specified above, as directed by the Engineer. When drilling in all types of rock, instructions given in IS 4078, 4464, 5313 and 6926 shall be followed.

During the drilling operation, particular attention should be paid to get the core recoveries and rock quality designations of the highest standards. Percentage core recovery and RQD should be indicated continuously from the depth starting from the level of highly weathered rock. If the core is broken by handling or during drilling, the fresh broken pieces shall be placed together and counted as one piece. This has to be done as the cores come out during drilling, with the permission of Engineer.

Soil samples and rock cores collected continuously to full depth of boreholes should be clearly marked with good quality oil paint. They shall be designated by number, arrows, depths, borehole to which it belonged etc. for the purpose of identification at a later date. Sketch pens or marker pens shall not be used for writing numbers on core pieces.

When bedrock is encountered, drill hole shall continue at least three meters in sound rock to ensure the continuity of the strata. If weathered or soft rock is met with, drill hole shall continue 5 meters into the rock layer. However, if heavily shattered rock due to various weathering process or weak rock zone susceptible to erosion when subjected to action of flowing water or any other types of rock which cannot be recommended as a founding strata is met with continuing 6 to 7 meters then the drilling shall continue through the weak zone

well into the sound rock below the top weak zone. Such incidences shall be brought to the attention of the Engineer and no borehole shall be terminated without the approval of the Engineer.

The characteristics/strength of rock with respect to weathering, hardness, joints and bedding and rock quality designation (RQD) as presented in Tables 2,3,4 and 5 in Appendix I of IRC 78-1983 shall be followed and the same shall be indicated in the bore logs.

Drilling through rock being a specialized work, every care shall be taken to notice and record any small change during drilling. The time required to drill through a certain depth, amount of core recovery, physical condition, length of pieces of core, joints, colour of water residue, weathering, and evidence of disturbance and other effects shall be carefully noticed and entered in the drill/core log. The directions given in IS 5319 – "Guide for Core Drilling Observation" may be followed while preparing the core logs.

The core boxes provided by the Contractor shall be sturdy and of good quality G.I.M.S. 18 Gauge and shall be made according to the sketch on Page 6 of IS 4078 (1980) with locking arrangements and compartments. The core boxes shall be painted inside with oil paints. Each and every core piece extracted from the core barrel shall be placed in core boxes in the proper sequence of occurrence from top downwards. The starting and finishing depth of each run shall be recorded on the core box compartments in oil paint as the cores are placed. They shall be sequentially numbered on the four sides and the lid. The name of the project, drill hole reference, and the depth of the core obtained shall be prominently painted on the lid with oil paint.

The depth of cores below ground level shall be indicated at about every 1.5m interval by writing the depth in indelible ink on wooden spacers that shall be inserted in their correct positions in the box. Similarly, the exact depth of any change in stratum and failure to recoverthe core etc. shall be recorded. The labelling of core samples of rock shall be done in accordance with the Appendix D of IS 4078 of 1980 or as directed by the Engineer.

Each core box shall house samples not more than 6 m long in total. While placing the core samples in the wooden boxes, it should be ensured that the direction and sequence of core placement is not altered. The core run shall be restricted to 500 mm to 600mm length at a time and the core sample removed as directed by the Engineer. The cores and core boxes shall be transported to a storing place as indicated by the Engineer.

The Contractor shall submit five copies of cabinet size (160mmx120mm) colour photographs of the selected cores as specified by the Engineer.

An arrangement should be made for collection of wash water by installing a top socket with a cross pipe at the top of the casing before the start of rock drilling. The side of the casing should be well packed near the top of the hole to prevent leakage. Wash water should be collected in buckets and allowed to settle. A record of wash water shall be maintained indicating colour, change in colour and type of wash water (i.e. thick slurry or clean water.

The number of revolutions per minute for the rock drilling shall be kept low (about 200 RPM) for "NX" size bits, with suitable reduction gear and bit pressure kept to a minimum without rod vibration on "chatter". The rate of penetration for every 250 mm shall be

observed during rock drilling and recorded.

Field bore logs shall be submitted to the engineer after completion of each borehole at site or as demanded by the engineer.

IN-SITU TESTING

The item covers conducting in-situ test and may include;

- Standard Penetration Tests
- Field Vane Shear Tests

a) Standard Penetration Test in Boreholes

The Standard Penetration Test [SPT] shall be carried out in boreholes at intervals as directed by the Engineer. Intervals shall not exceed 3 m according to Indian Standard Code of Practice.
For details of the sampling tube (spoon) and equipment and procedure for conducting a penetrometer test, the IS Code 2131 (1963) shall apply. The driving monkey should be provided with suitable arrangement for controlling the height of fall. It should be ensured that blowing in of fine sand is avoided while conducting penetrometer tests. For this purpose, it may be necessary to use mud (Bentonite) circulation or create surcharge pressure.

For SPT the blow count shall be recorded at intervals of 150mm, for a total penetration of 60mm. The SPT blow count shall be reckoned as the total number of blows for the second and third penetration increments of 150mm.

Every attempt shall be made to recover the full sample from the standard split spoon sampler. Where sample recovery is poor or nil, a representative sample shall be preserved from the sludge pump/bailer sample.

Whenever a sample recovery is recorded, the following details shall be noted along with usual record of blow counts. This information shall be recorded for each borehole, in a format approved by the Engineer.

- Penetration and blow counts (meters)
- Recovery (meters)
- Logging of silt and fine sand, if any, observed.
- Description of soil sample.

In the case of stiff to medium clay where a sample is recovered in the form of a "cake" a suitable length of cake shall be wrapped with a layer of bandage cloth and coated with paraffin wax to preserve the sample.

The identification tag for the sample shall be carefully secured to the plastic container in which samples are preserved.

b) Field Vane Shear Test

Field Vane Shear Test shall be conducted as stipulated in the relevant IS codes. During boring operation, when soft clay layers are encountered the same shall be brought to the notice of theEngineer who shall decide whether Vane Shear Tests are to be conducted in such strata.

LABORATORY TESTING

All the specified laboratory tests shall be conducted in a nationally accredited laboratory in consultation with the Engineer. Such laboratory should have recognition from the National Highways Authority of India, Government of India. The relevant Indian Standard Codes of Practices for Soil Testing shall be followed.

For preparing the laboratory test schedule, a list of all soil and rock core samples collected from each borehole shall be submitted to the Engineer with records of bore logs and in-situ tests in duplicate. One of the copies shall be returned to the Contractor indicating the tests to be conducted. All the consolidation and permeability tests on collected samples shall be conducted at the laboratory of reputed institutes like IIT or as approved by the engineer.

The results including plots and tables shall be submitted along with the report. Test observations and calculations shall be made available to the engineer if demanded.

Preparation of Test Specimens

Preparation of test specimens for the various tests shall be carried out as per the procedures laid down in the various relevant Codes of Practice.

In case of soft to firm cohesive undisturbed soil samples, test samples for all types of shear tests shall be prepared strictly by hand trimming or soil lathe. Care shall be taken against bending of soil samples at the time of horizontal ejection of the samples from the sampling tubes. Samples shall be ejected from the sampling tubes preferably in the same direction of travel in which the samples entered the sampling tubes.

Similarly test specimens for consolidation tests shall also be prepared to the required size by hand trimming only and the ring of the consolidation apparatus shall be inserted by pressing gently with the hands and carefully removing the material around the ring. In no case the ring shall be forced into the soil. Great care shall be taken during the trimming of the sample from the top and the bottom of the ring. The test specimen shall be prepared in the same orientation as that of the actual strata so that the laboratory test load compresses the soil in thesame direction relative to the soil strata as the applied load in the field.

Index Property Tests

Laboratory tests shall be carried out in consultation with the Engineer and as per relevant parts of IS:2720 to find out the following index properties:

Natural Moisture Content Sieve and

Hydrometer analyses Atterberg Limits

Specific gravity

Bulk and Dry Density

The soil samples to be tested shall be selected by the Engineer

Unconfined Compression Test

Rock samples having L/D ratio not less than 2 shall be prepared and tested under soaked

condition for uniaxial crushing strength as per IS:9143 and IS:9221. The stress-strain relationship and modulus of elasticity shall also be reported. Bulk and dry densities, porosity, water absorption, specific gravity shall also be determined on rock samples as per IS:1124.

Triaxial Test

Unconsolidated, undrained triaxial test shall be conducted on the undisturbed samples selected by the Engineer. The test shall be conducted as per IS:2720 (Part X). Each test shall be conducted on a minimum of three specimens at different cell pressure (1.0, 2.0 and 3.0 kg/cm2).
The moisture content before and after the test and the bulk and dry densities of each specimenshall be determined. The rate inserted by the tenderer in the bill of quantities for the triaxial compression test shall include for all the above items.

The stress-strain diagrams as well as the Mohr circle envelopes shall be included in the report.

- **Consolidation Test**

Consolidation test shall be conducted on undisturbed samples as per IS:2720 (Part XV) selected by the Engineer. The loading on the test specimens shall be applied in the following stages: 0, 0.1, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0 kg/sq.cm. Unloading of the test specimens shall be done in suitable stages. The co-efficient of consolidation (Cv), the coefficient of volume compressibility (Mv), compression index (Cc) and the coefficient of permeability (k) shall be determined and reported.

- **Chemical Analysis**

Chemical analysis of soil and water samples shall be carried out for pH value, sulphate content (SO3) and chloride content (CI) in ppm and percentage.

2. CODES AND STANDARDS

All field and laboratory work shall be carried out strictly in accordance with IS Codes of Practice and these specifications, unless otherwise approved by the Engineer in writing. In case of conflict, the IS Codes of Practice shall prevail unless otherwise instructed in writing by the Engineer.

3. REPORTING REQUIREMENTS

The work includes the preparation and submission of an Investigation Report containing plans showing the location of boreholes including coordinates and levels, plans showing boreholes, project details and description of work carried out, bore logs, core logs, field test results and laboratory test results. Report should also contain interpretation of test results, recommendations for founding levels and bearing capacities, potential settlements and groundimprovement.
The recommendations shall especially cover the Foundation types, founding levels and bearing capacity for the structures as identified in the project description and as shown in the drawings. The foundation types and founding levels shall be clearly identified.

Report shall also cover Safe Bearing Capacity and settlement analysis for shallow foundations, retaining walls and ground improvement techniques.

The report shall include commends on aggressive chemical content of soil and groundwater and recommendations for deciding level of protection necessary for concrete and steel buried parts.

CLAUSE A-4 VOID FORMER

Void formers are to be supplied with suitable end blockers to seal the void former ends.

Specialized form work shall be manufactured by use of form lining materials with ring stiffeners as per design requirements. The form lining shall be of Galvanized steel sheet of appropriate thickness (0.7mm) and the ring stiffeners should preferably be of structural steel sections. Manufactured void formers shall be absolutely leak proof.

The Void Formers shall be strong enough to withstand all pressure, ramming and vibration during placing of concrete and handling/erection stresses. The void formers shall be placed and tied in position so that they are not displaced during concreting.

All the steel surfaces shall be painted in accordance with Section 1900 of the Technical Specification, before use of Void Formers.

The contractor shall furnish the design and drawing along with detailed specifications of the proposed Void Formers for approval of Engineer before taking up the work.

Rate: The payment for void former shall be made in linear meters which shall include cost of supply, transport, fitting fixing in position and all other incidental expenditure complete in all respect as per specification & direction of Engineer.

CLAUSE A-5 PVC DOWNTAKE PIPE

1. Scope

The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, jointing etc., for service duct or drain water pipe line.

2. Material

The pipes and fittings shall conform to series IV of IS 4985-1978. PVC pipes and fittings shall be free from cracks, flows and defects.

3. Construction Methodology

Before laying pipe line, it shall be first examined for damages and cracks. No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost.

All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside surface.

The pipes shall be carefully laid straight to the correct alignment as indicated in the drawing. All pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer.

The joining of pipes and fittings generally shall be done with approved make cement solvent including making surface rough. The pipe shall be cut to desired length. Care shall be taken that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

4. Measurement and Rates

The payment shall be made on running meter of pipe fixed in position. Unit rates includes,

i. Supplying of PVC pipes and fittings of specified diameter.

ii. Laying and cutting the pipe wherever necessary and wastage.

iii. Fixing the pipeline with GI clamps not less than 2 mm thick and GI nails length not less than 40 mm or with PVC clamps, screws, wooden guttiesetc.

iv. Making the solution joint.

v. All necessary materials, labour and used of tools required to complete the job.

The measurement shall be taken along the longitudinal axis centre to centre, which includes fittings, making joint etc.

CLAUSE A-6 TEMPORARY BARRICADE

1. Scope

(i) Arrangement of temporary barricade for enclosing the construction zone with traffic signals during construction at site, for day and night as per instruction of Engineer and drawings.

(ii) Once barricade has been provided and work started, removal of barricade is not permitted till completion of viaduct including construction of pile, pile cap, pier and pier caps. Erection of girders, segments till completion of entire super structure.

(iii) While erecting barricade, the bottom gap between barricade and road should be plugged with cement concrete from inside.

(iv) There should be minimum openings at the end of barricade to allow access of Lorries andmachine to site work area. Even these spacing should have proper opening/closing arrangements.

(v) Adequate blinking lights on barricade during night time must be ensured. The cost of this item should include provision for power pack/ Generator set etc. so as to ensure the blinking of lights in night time as long as barricades are in position at the work spot.

(vi) After completion of the entire work, the release barricades will be the property of the contractor and he is also responsible for shifting all such release materials away from the site. Barricade shall be constructed with MS Plate with 6mm thickness and 50mm X 50mm MS angle, all other materials, including cutting, transporting to site, fabricating, setting out, etc. complete as per drawing and MoRTH's Specifications Sections 1900 andas directed by Engineer.

(vii) Barricading may be required to be shifted laterally number of times but the same will be paid only once.

2. Payment

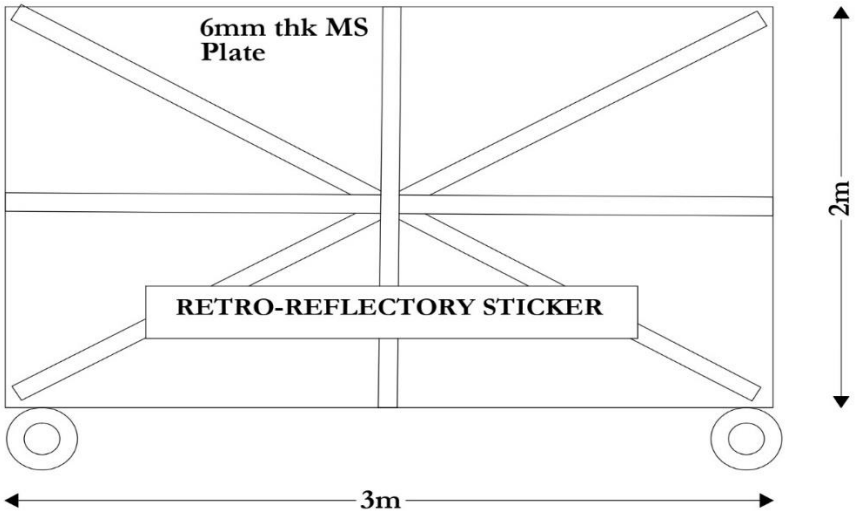
This item will be payable only at two stages of construction. First stage involves construction of foundations and substructures: (pile, pile cap & pier) and Second Stage: superstructure viaduct. In both the stages of construction, the barricading and arrangements for traffic diversion has to be kept continuously. Nothing extra will be paid for dismantling, shifting and re-erecting the barricades the traffic signals and other arrangements at the same place/stretch within the same stage. The construction of barricading will be limited to a width of 5.0m (outside to outside) of barricading for 2m height.

(Note: Barricading may be required to be shifted laterally number of times but the same will be paid only once).

The Payment schedule for item shall be as follows:

i) On completion of Piling, Pile cap, open foundation and piers as approved by Engineer 50% of accepted amount.

ii) After completion of all activities of Viaduct including removal of barricades and restoration of site with latest specification and as per the instructions of the Engineer, 50 % of accepted amount.



(Typical)